DEMO: FLARE: Federated Active Learning Assisted by Naming for Responding to Emergencies

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***Abstract*—Name-based pub/sub allows for efficient and timely delivery of information to interested subscribers. A challenge is assigning the right name to each piece of content, so that it reaches the most relevant recipients. An example scenario is the dissemination of social media posts to first responders during disasters. We present FLARE, a framework using federated active learning assisted by naming. FLARE integrates machine learning and name-based pub/sub for accurate timely delivery of textual information. In this demo, we show FLARE's operation.**

I. Introduction

People actively use text-messaging, news platforms and social media for widespread dissemination of information during disasters. Free-form text, such as Tweets and social media posts, often communicate critical information. The posts by the victims of disasters, if forwarded to the right first responders in a timely manner, could prove to be life saving.

Information-centric and name-based delivery (either request/response [1] or pub/sub [2]) provide significant benefits for structured dissemination of content to large groups of people. A namespace, often a hierarchical structure, provides a robust interface for all participants. In name-based delivery, each publication message needs to have the correct name, in order to reach all the relevant/intended recipients. This can be challenging in many situations, such as disaster scenarios, where many users who generate content (*e.g.*, incident reports on social media) may not know or have access to the namespace. Therefore, it would be helpful to have those social media posts (SMPs), such as Tweets, be mapped to the right subset(s) of the incident namespace, leading to the right first responders receiving those SMPs so they can deal with the specific task related to the incident. An important aspect of such mapping is machine learning and natural language processing procedures to find the right names related to the content. There have been many works that classify text in Tweets from disasters [3], [4], [5]. We seek to leverage such classification techniques so that they can be disseminated in real time in our pub/sub framework, while taking advantage of the namespace to direct the tweets appropriately.

We propose FLARE, a framework for efficient and timely dissemination of relevant posts to the right first responders, assigned to different incident response roles, using specialized knowledge available to participating departments. FLARE consists of DNN-based learning and classification modules to analyze textual content and mapping them to the right NLP class, which is associated with a point in the namespace. The formed name, assigned to the content (*i.e.*, text, tweet, *etc.*.), facilitates name-based delivery and dissemination. This abstract describes the major components and setup of FLARE, as well as example scenarios of its usage. The major contributions of this work are: 1) an application of ICN for a real-world use case and data; 2) a solution for assigning accurate names to large amounts of free-form content, streamlining name-based delivery.

II. Architecture & Demo Setup

A. Architecture Overview

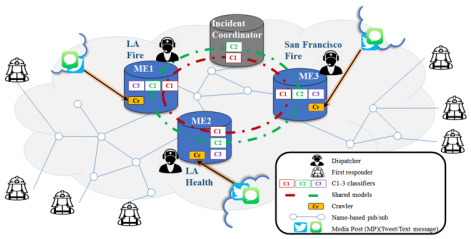

Fig. 1. Overall architecture of FLARE

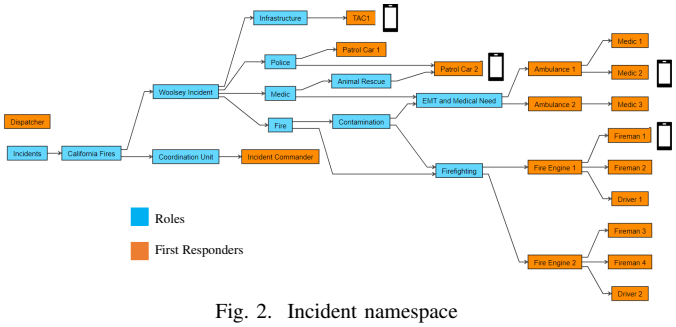

Fig. 2. Incident namespace

An overview of the architecture of FLARE is presented in Fig. 1. In the figure, the C1, C2 and C3 components are ML-based classifiers, to classify the text in accordance with the different levels of the namespace (more details in [6]). For example, C1 determines whether a text is relevant to the incident or not. The relevant texts are then passed to C2 (to determine the high-level organization/department), and then the C3 classifier for further classification into fine-grained roles within a department as specified in the namespace. Our demo implementation shows how a media engine (ME) uses these classifiers, and the namespace, to deliver the text messages to the right first responders. This task is performed, for the most part, by the cooperation of multiple MEs, belonging to different organizations, in a federated manner.

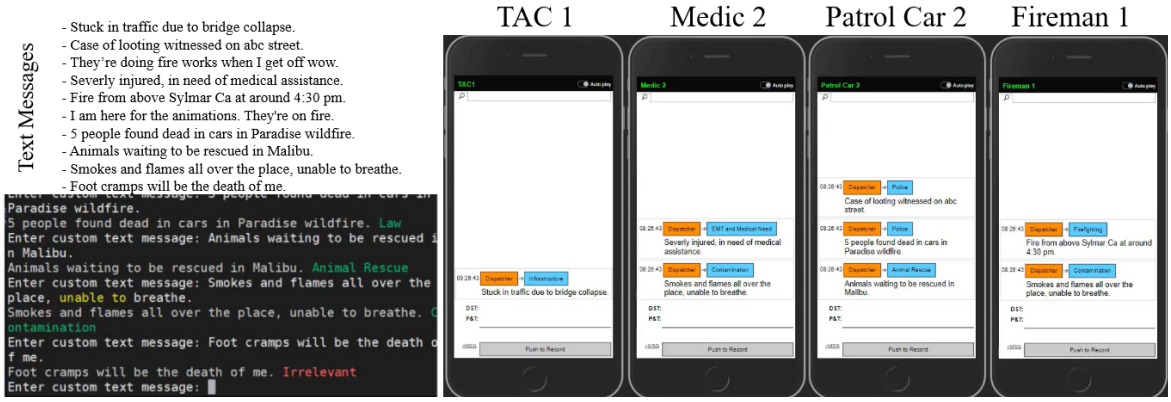

Fig. 3. Dissemination output of FLARE

B. Namespace

The namespace is an integral part of FLARE. Fig. 2 shows an example of the Incident namespace, with different roles. In the graph here, we see different roles in blue boxes, such as 'Infrastructure', 'Police', 'Animal rescue', *etc.* The entities shown in orange, such as 'TAC1', 'Patrol Car 1', 'Patrol Car 2', 'Medic 1', etc. are the first responders who subscribe to these roles. The first responders receive messages on their mobile devices for the roles they are subscribed to. A role in the namespace may be assigned to multiple first responders. For example, we can see that 'Fire Engine 1' and 'Fire Engine 2', are both subscribed to the role of 'FireFighting'. Along with this, we also see that a first responder can subscribe to multiple roles. For example, 'Patrol Car 2' here is subscribed to both the 'Police' and 'Animal Rescue' roles. Roles and role-to-role relationships can be created and deleted during the disasters. Additionally, users can subscribe to/unsubscribe from roles based on their tasks and/or interests. The four mobile device icons shown next to 'TAC 1', 'Patrol Car 2', 'Medic 2' and 'Fireman 1' indicate the physical smartphones we will use in the demo to show the messages received by these 4 mobile devices as they arrive.

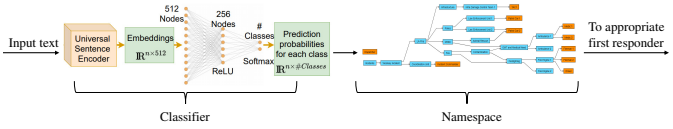

Fig. 4. FLARE's pipeline

C. Pipeline of Data Processing

Fig. 4 shows the pipeline used in FLARE through which the input text message is redirected to the appropriate first responder. The text input is passed to the DNN-based classifier. The classifier can provide classifications belonging to different roles of the namespace. Then based on these classifications, the input text is published to the right roles of the namespace. The first responders who subscribe to these levels get the text messages and can act upon them.
to the mobile devices of the correct first responders. We use

III. Scenario

Fig. 3 shows a snapshot of our demo, showing the 4 mobile devices and example inputs and outputs. In the demo, we show how incoming text messages are classified and delivered the namespace shown in Fig. 2. The namespace can be created upon the occurrence of the incident, and go through changes during it. The 4 mobile devices belong to TAC 1, Medic 2, Patrol Car 2 and Fireman 1. On the left side of Fig. 3, we see the text messages that we pass to the classifier/media engine. The classifiers are trained through federated and active learning procedures. As seen in the figure, after the classification, the tweets are delivered to the corresponding mobile devices. All the first responders received the messages based on their subscriptions. The interesting thing to see here is that Patrol Car 2 receives text messages for both 'Law Enforcement' and 'Animal Rescue' since it was subscribed to both of those roles. With this experiment, we demonstrate FLARE's ability to accurately classify text messages and deliver them to the right first responders, using the incident namespace.

IV. Conclusion

We will demonstrate FLARE, a framework using federated active learning assisted by naming. FLARE processes incoming tweets, processes and classifies its text, and maps it to the right name for name-based pub/sub, which allows dynamic naming and subscriptions. Our work shows a practical use case of ICN, as well as proposes a method to intelligently assign the right name to information.

V. Acknowledgements

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References

[1] L. Zhang *et al.*, "Named data networking," *ACM SIGCOMM Computer Communication Review*, vol. 44, no. 3, pp. 66–73, 2014.
[2] J. Chen *et al.*, "COPSS: An efficient content oriented publish/subscribe system," in *ANCS*, 2011.
[3] M. Imran *et al.*, "Twitter as a lifeline: Human-annotated twitter corpora for nlp of crisis-related messages," *arXiv preprint arXiv:1605.05894*, 2016.
[4] D. T. Nguyen *et al.*, "Rapid classification of crisis-related data on social networks using convolutional neural networks," *arXiv preprint arXiv:1608.03902*, 2016.
[5] M. Y. Kabir and S. Madria, "A deep learning approach for tweet classification and rescue scheduling for effective disaster management," in *SIGSPATIAL*, 2019.
[6] V. Mittal *et al.*, "Flare: Federated active learning assisted by naming for responding to emergencies," in *ACM ICN*, 2021.